

## REPORT ON RELOCATING THE UPSTREAM ENCLOSURES OF THE N5/N3 BEAMLINES

A. MALENSEK

November 12, 1979

### INTRODUCTION

It now appears that a portion of the Tevatron Shield<sup>1</sup> will be installed during the 1980 spring/summer shutdown. The Tevatron Shield is a 6 foot steel rod centered on the N0 beam line ( $X = -0.667'$ ). It will begin at Enclosure 100 and extend downstream about 150 meters. Once the steel is in place the N5/N3 beams cannot run, since these beam lines would then be inside the 6 foot radius of the steel. Accommodating the N5/N3 beam lines by having a hole in the shield is not acceptable, since the effectiveness of the shield is then compromised. This report summarizes the results of a design which keeps the N5/N3 beams running after the steel is in place. The primary proton beam (New N7) is envisioned to be bent east slightly and follow the N0 berm outside the present decay pipe. A rough sketch is shown in Figure 1, which also shows the position and angle the primary beam hits the target. Reasonable values of position and angle have been chosen to give a starting point for the new N5/N3 designs, and should be achievable with a wide variety of New N7 designs.

### DESCRIPTION OF THE DESIGN

The following constraints were used for the design criteria:

- A.) Match into as much of the "downstream" end of the present N5/N3 beams as possible.
- B.) Have an acceptance comparable to the existing beams.
- C.) Have a small beam divergence in regions where differential  $\bar{C}$  counters are located, so particle tagging can be accomplished.

- D.) Have the capability of controlling the momentum bite of the beam.
- E.) Obtain a "reasonable" spot size at the experimental detector.
- F.) Accomplish all of the above at minimum cost.

The basic design and ideas of the proposed beam can be understood by noting the changes between it and the existing beam lines. First, the momentum collimator is moved from Enclosure 103 to the upstream end of Enclosure 105. This requires Enclosure 105 to be extended about 10 feet in the upstream side. Second, the magnet arrangement is changed in Enclosure 103 to maintain the same bend point, however, the physical building remains unchanged. Third, a new enclosure (Enclosure 101E) is built about 10 feet east of the present Enclosure 101. This new enclosure becomes the target station and serves a similar function as the present Enclosure 100. The beam dumping scheme follows the same ideas as the existing beam which are described in detail in the Addendum to TM-805.

The design minimizes cost because it matches into the N5 and N3 lines far upstream and uses all present enclosures with the exception of Enclosure 101. Enclosure 101 will have to be moved in any case when the steel is installed. The new design requires two additional main ring magnets to operate at 400 Gev. (Two 3Q84 magnets or one 3Q84 and one 3Q52) No new power supplies are needed. In addition three 3Q120 and two 3Q60 magnets and their associated power supplies (5D00,5F00) are not used and would be available for use in a New N7 design. Figures 2 and 3 show the new magnet positions. The principal rays for the new beams are shown in Figures 4 and 5. Table I contains the new bend points, Table II compares the most important beam qualities, and Table III gives the new quad tunes for 400 Gev.

1. Mori, S., "Muon Shield for the Tevatron at Fermilab", TM-790, May 17, 1978.

TABLE I

LOCATION	ELEMENT	BEAM	Z(ft)	X(ft)	$\theta$ (mr)	$\theta$ (Total-mr)
Enc. 101E	Target	N5/N3	5375.0	-14.076	-7.768	- 7.768
Enc. 101E	5B01T	N5/N3	5387.0	-14.169	-2.741	-10.509
Enc. 101E	5E01	N5/N3	5482.5	-15.173	-5.848	-16.357
Enc. 103	5E03	N5	6099.6	-25.331	-14.543	-30.900
Enc. 103	3E03	N3	6099.6	-25.331	-17.543	-33.900

TABLE II

	ACCEPTANCE μSTERADIAN-%	DIVERGENCE IN C REGION (RMS)	BEAM SIZE AT DETECTOR (RMS)	COMMENTS
N5	3.1	X'=0.03 Y'=0.04	X=3.1 mm Y=1.3 mm	
New N5	5.1	X'=0.06 Y'=0.06	X=1.9 mm Y=4.8 mm	
N3	0.5 *	X'=0.10 Y'=0.06	X=0.4 cm Y= 4 cm	(Note 1)
New N3	1. *	X'=0.07 Y'=0.07	X=0.4 cm Y=2.5 cm	(Note 1)

\* Uses a collimator setting to restrict the momentum bite to about +0.25% (RMS).

Note 1: The horizontal size at the 30" Bubble Chamber is controlled by the momentum collimator; the vertical magnification is large at the Bubble Chamber. These two characteristics are maintained in the new design. The vertical size in the new N3 can be made larger by slightly tuning the last two quads.

TABLE III  
400 GeV Tunes

BEAM	Z (ft)	POSITION	FIELD(kg/in)	MAGNET SOURCE WITH RESPECT TO N5/N3	
N5/N3	5450.5	5D01-1	-4.32019/-4.32751	5D01	(3Q84)
N5/N3	5459.0	5D01-2	-4.32019/-4.32751	5F01	(3Q84)
N5/N3	5467.5	5D01-3	-4.32019/-4.32751	NEW	(3Q84)
N5/N3	5497.5	5F01-1	4.39042/ 4.41794	5F03	(3Q84)
N5/N3	5506.0	5F01-2	4.39042/ 4.41794	5D03	(3Q84)
N5/N3	6053.1	5D03	-1.99657/-3.06310	5F00-2	(3Q60)
N5	6572.5	5F05	5.91450	5F05	(3Q84)
N5	6651.0	5D05	-5.57089	5D05	(3Q84)
N5	6786.6	5F06	3.79738	5F06	(4Q120)
N5	7203.5	5D09	-2.66531	5F09	(3Q84)
N5	7278.0	5F09	3.02426	5D09	(3Q84)
N5	7703.0	5D13-1	-5.18335	5D13-1	(3Q52)
N5	7710.1	5D13-2	-5.18335	5D13-2	(3Q52)
N5	7742.4	5F13-1	4.95690	5F13	(3Q84)
N5	7749.6	5F13-2	4.95690	NEW	(3Q52)
N3	6596.3	3F05	4.28688	3F05	(3Q84)
N3	6643.3	3D05	-4.51055	3D05	(3Q84)
N3	----	3F08	NOT USED	----	(4Q120)
N3	7562.5	3D12	-2.38578	3D12	(3Q120)
N3	7689.7	3F14	2.03534	3F14	(3Q120)



$$\theta = -7.768$$

FIGURE 1

ENC. 101

TM-921  
2960.0

6

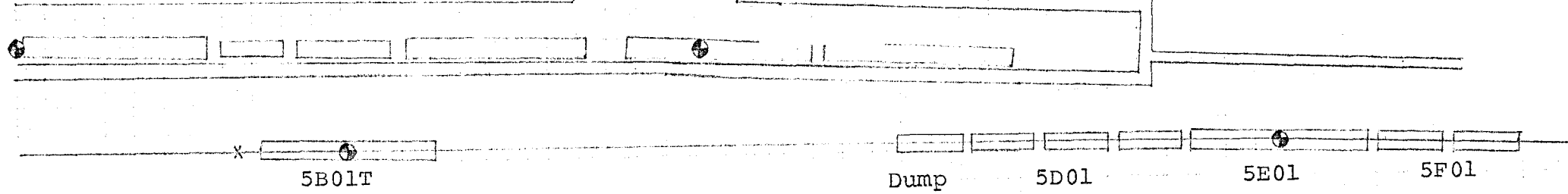
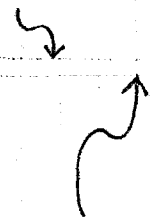


FIGURE 2

N5/N3



NEW N5/N3

5D03 5C03V

5E03

ENC. 103

FIGURE 3

# PRINCIPAL RAYS — NEW N5

TM-921  
2960.0

7

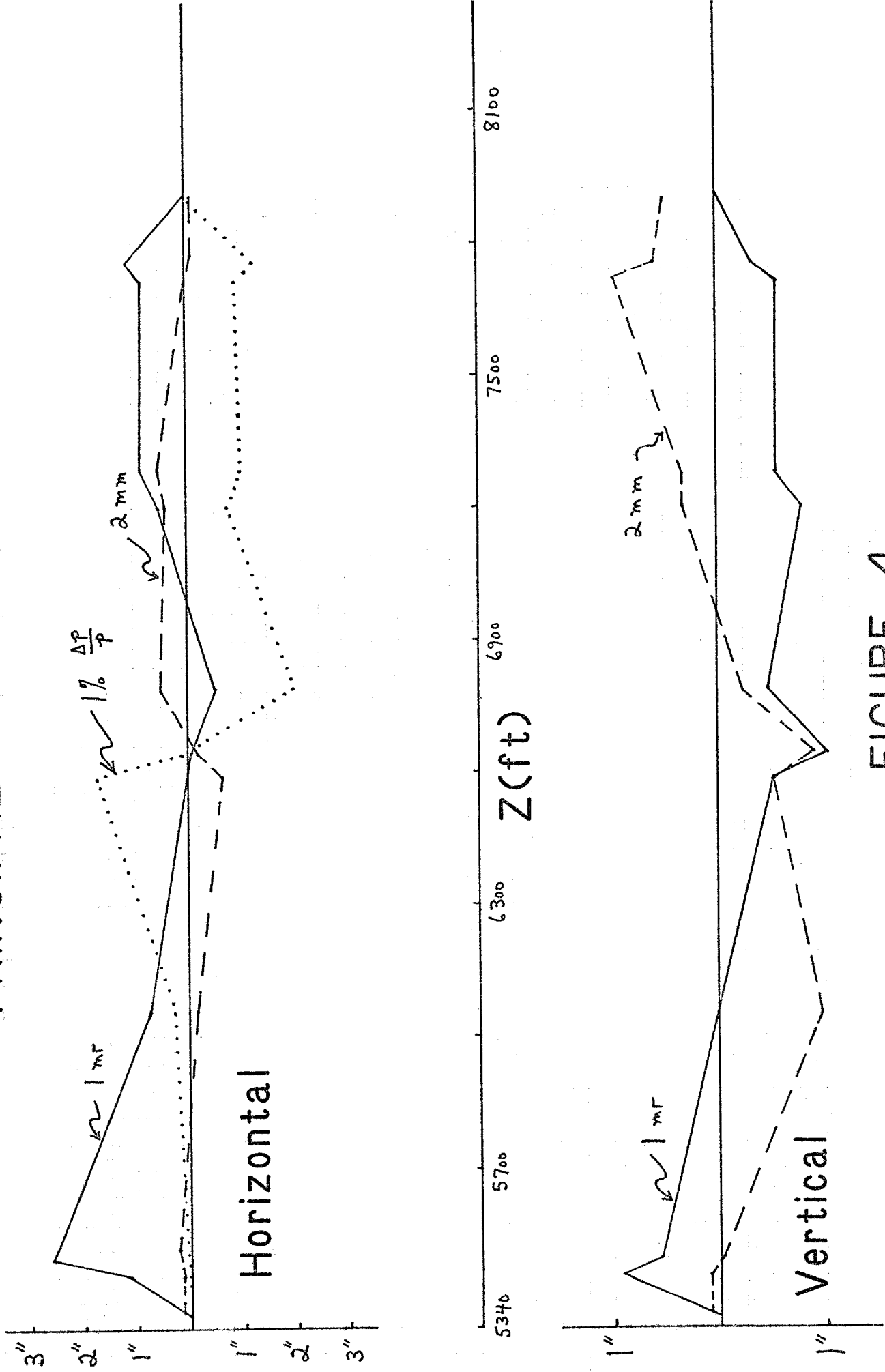


FIGURE 4

# PRINCIPAL RAYS—NEW N3

TM-921  
2960.0

8

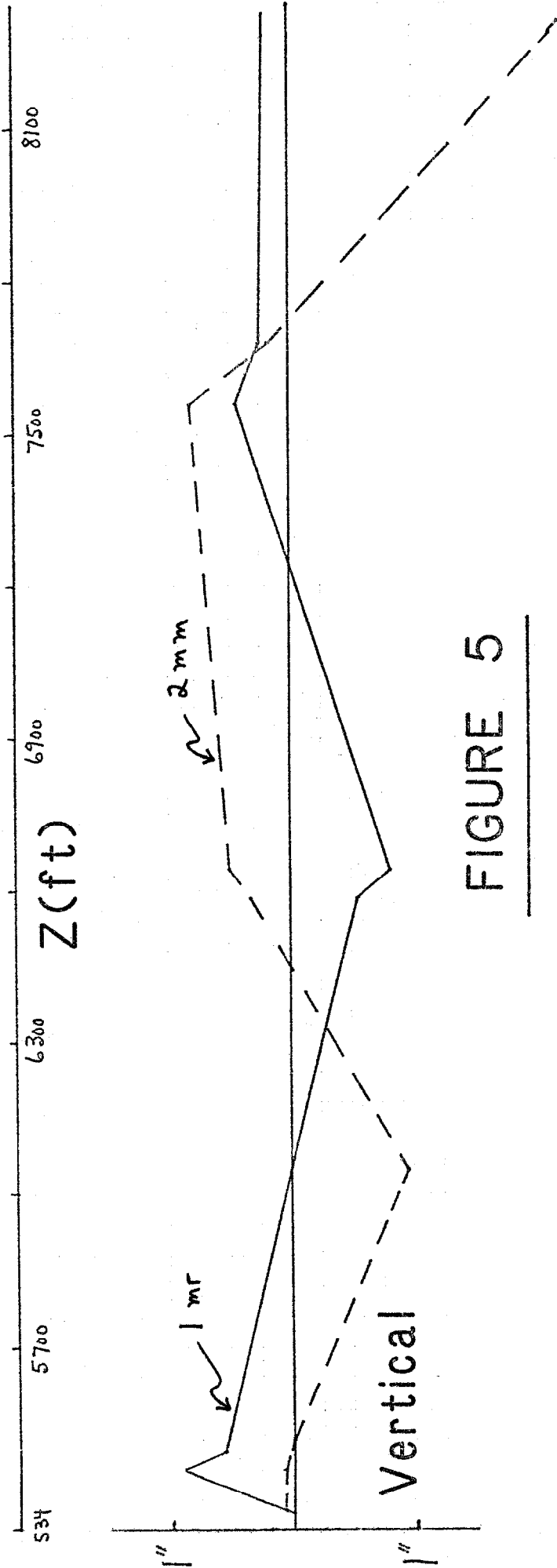
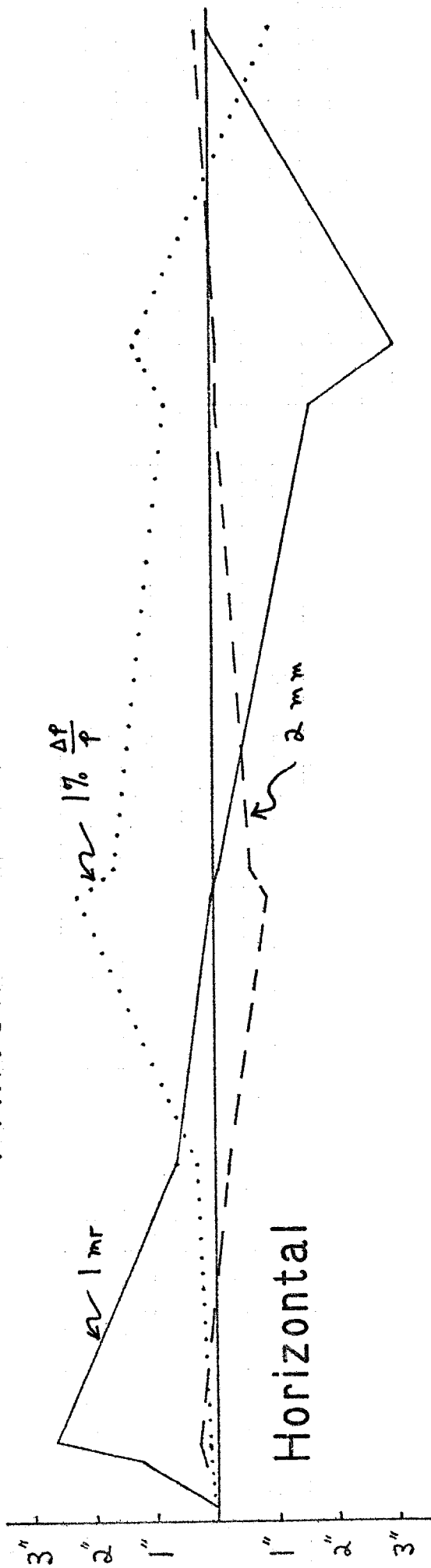


FIGURE 5